COMPARATIVE EVALUATION OF FRACTURE STRENGTH OF ROOT CANAL TREATED TEETH BETWEEN WAVE ONE AND THE HYFLEX FILE SYSTEM: AN IN VITRO STUDY

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ABSTRACT

Background: The purpose of this study was to evaluate the fracture strength of roots instrumented with the Wave one reciprocating file (Dentsply Maillefer, Ballaigues, Switzerland) and Hyflex CM (Coltene/Whaledentinc, Usa) and filled with the warm vertical compaction technique.

Materials and Methods: In total, 60 mandibular premolar teeth were sectioned at or below the cementoenamel junction to obtain roots 13 mm in length. The roots were balanced with respect to buccolingualmesiodistal diameters and weight. They were distributed into 2 experimental groups and 1 control group (n = 20): no instrumentation (control group), instrumentation with Wave One with obturation, instrumentation with Hyflex CM with AH Plus sealer (Dentsply DeTrey, Konstanz, Germany) was used along with single cone points. One week later, a vertical load was applied to the specimen's canal until fracture occurred. Data were statistically analysed using 1-way analysis of variance (P=0.05).

Results: The median fracture load was 415.74 N for the Waveone, median fracture load of 393.83N. However, the differences were not statistically significant (P=0.08).

Conclusion: Instrumentation with the WaveOne and Hyflex CM system showed highest fracture resistance strength of standardized roots with respect to cross-sectional diameter and weight.

Key Words: Fracture Strength, instrumentation, vertical root fracture, Wave One reciprocating file
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INTRODUCTION

One difficult complication that may arise during or after root canal therapy is vertical root fracture (VRF)[1-2]. Endodontically treated teeth are susceptible to fracture because of a number of causes, including tissue loss, dentin dryness, and the loss of undesired tooth structure. These concerns might also arise from previous disease or endodontic and/or restorative operations[3-6] the consequences of irrigation solutions and too much pressure applied during the filling process VRFS (vertical root fracture) coronal and radicular therapy have been shown to be caused by physical trauma and repetitive hard and stressful chewing. According to recent reports, fissures in the apical region may also spread as a result of root canal filling treatments[7] Fewer investigations, meanwhile, made the assumption that the load produced during cold lateral compaction is often less than theload.It is not necessary to break the roots unless the roots are really weak[8-9].Therefore, it's yet unknown if root canal therapy can result in VRF[10]. Technological developments in rotary nickel-titanium instruments over the past few decades have resulted in improved root canal shaping and new design concepts that are simpler, quicker, and more effective in nickel-titanium (NiTi) tools have given root canal therapy new perspective[11].

Single-file systems in reciprocating and rotating motion have just been released. Different file systems with different design features—such as the NiTi core diameter, cross-sectional shape, rake angle, and flute depth—may have an impact on the file's behaviour, which in turn may have an impact on the formation of fractures[12] Control memory for Hyflex NiTi has been produced using an exclusive method that regulates the Hyflex rotary instruments (Coltene-Whaledent, Allstetten, Switzerland) are another type new

NiTi system. Hyflex instruments have anon-symmetric cross sectiondesign with 3 cutting edges[13]Excessive taper can causeremoval of excess dentin androot weakening[14] Effects of using rotaryinstrumentsandinstrument enlargement. Root fracture\insensitivity is still controversial [15-17]Cross-sectional anatomy of root canals\appears; flat, oval and C-shaped canals arewidely found[18] although rotarysystems tend to produce rounder chickens.Preparations and smoother canalwalls.[19]Reciproc and Wave One files are used in a reciprocating motion that requiresspecial automated equipment. Reciprocal filesare available in different sizes (i.e. 25.08, 40.06 and 50.05), while Wave One consists of sizes 21.06, 25.08 and40.08. The reciprocal movement relieves the stress on the instrument with alternating counter-clockwise (cuts)\ and clockwise (releasing the instrument) movements andreduces the risk of cyclic fatigue due to stress and pressure. Reciprocal anglesare specific to certain instrument designs[20].The purpose of this in vitro study was to identify the effect of Wave One file and Hyflex CM instruments on non-root fracture strength.

MATERIALS AND METHODS

A total of sixty undamaged and excised human mandibular premolars were chosen, and they were kept in distilled water with a single straight root canal. All teeth had their coronal sections removed using a diamond-coated bur while the water was cooled, leaving roots that measured around 13 mm in length. Using a stereomicroscope magnified 10 times, the teeth were inspected for cracks or craze lines. Teeth exhibiting such results were substituted with teeth that were comparable and removed from the study. A computerized calculator was used to calculate the buccolingual (BL) and mesiodistal (MD) dimensions of the root canals in order to guarantee that roots with uniform dimensions and weights were utilized.The BL and MD diameters were then multiplied. Mesiodistal (MD) dimensions of the root canals were measured using a digital caliper. Subsequently, the BL and MD diameters were multiplied. The weights of the roots were measured with a sensitive precision balance. We evenly distributed the roots to each group in an active sense based on their weights and the homogeneity of the groups. This parameter was by using the analysis of variance test. The roots were distributed into 2 experimental groups and 1 control group (n = 10).

Control Group 1: No Instrumentation or Obturation The root canals were not shaped or filled. These were used as the control.

Group 2: **Instrumentation with Hyflex CM Regenerative Files and obturation** The root canals were shaped with The canals were prepared with up to master apical file size X3 (#25/4% taper) to working length.

Group 3: **Instrumentation with Wave One Files and obturation** The root canals were shaped with The canals were prepared with up Root canals were prepared with wave one file (DentsplyMaillefer, Ballagues, Switzerland) The canals were prepared with up to master apical file size of D2 (#25/8%taper) in slow in-and-out pecking motion until reaching the full working length according to the manufacturer's instructions. The flutes of the instrument were cleaned after 3 in-and-out-movements (pecks). Apical patency was maintained by passing #15 Kfile(Mani co. India) through the apical foramen between files. During the preparation, after each instrument the root canals were irrigated with 2 ml of 2.5% NaOCl solution. After instrumentation, a final flush was done using 5 ml 17% EDTA for 1 minute, 5 ml 2.5% NaOCl for 1 minute followed by 5 ml distilled water. Obturation – AH plus (Dentsplydetrey, Konstanz, Germany) was coated with paste carrier – lentulo spiral(size1, 21mm red) into the root canal to the working length.

Obturation of the roots was done with single cone # 25, 6 % taper (Diadent, Seoul, Korea). After completion of the filling, the excess material was removed and condensed with a cold plugger for 5 seconds, cavity was sealed with Glass Ionomer cement as final restoration. After instrumentation and filling procedure the roots were kept at 37°C with 100% humidity for 7 days to allow complete set of sealer. The roots were kept wet in humidifier for 7 days to prevent dehydration.

Mounting of Roots and Fracture Measurement Mounting of roots in acrylic resin block and fracture measurement by using instron testing machine. Acrylic resin blocks were prepared using cylindrical plastic molds (25mmhigh and 110mmin diameter). Self-cured acrylic Gite R.et al, Int J Dent Health Sci 2016; 3(6):1032-1039 1035 resin (Imicryl, Konya, Turkey) was used to prepare the blocks. The apical root ends were embedded vertically in 4 mm of the acrylic resin, exposing 9 mm of the coronal portion of each root. The roots were kept wet with a wet towel to prevent dehydration until they were ready for strength testing. Tesing of samples - Instron testing machine (Instron, Canton, MA) running at a crosshead speed of 1 mm/min was used to fracture the roots. A steel conical tip (tip diameter = 1.0 mm, tapered at 60º) was mounted and aligned with the center of the canal orifice parallel to the long axis of each specimen. The load necessary to fracture were recorded.

RESULTS:

Group	No. samples	BL(mm)	MD(mm)	Multiplication of the BL-MD diameter(mm^2)	Weight(g)	Fracture load(N)
Control	20	5.88	3.93	5.88x3.93	433g	118.70
Hyflex cm	20	6.07	4.19	6.07x4.19	406g	393.83
Wave one	20	6.02	4.08	6.02x4.08	448g	415.74

TABLE 1.Cross-sectional diameters, multiplication of theBL-MD diameters, weights, and fracture loads of the roots.

DISCUSSION: A crucial element in mechanical testing is sample standardization. Variations in the roots' dimensions, the length of the extraction process, and the storage conditions could all impact a study's findings. In earlier investigations on fracture load. The weights of the roots were not included in the measurements of the BL and MB dimensions. The same process was used in the current investigation to exclude out dimension variations as possible sources of confounding. A statistical analysis of the roots' weight and cross-sectional diameter revealed no discernible variations between the groups. The current findings indicate that there is a medium association between fracture loading and the weight of the soft roots. The BL-MD diameter's multiplication, however, does not significantly correlate with fracture loading. These outcomes support those of. These results corroborate those of previous studies. Bilge GulsumNur et al investigated that fracture resistance of the roots instrumented with WaveOne and Reciproc file systems were similar to the control group and it was observed that OneShape rotary file systems enhance the fracture strength of standardized curved roots when compared with untreated specimen. PrashantMonga et al in 2015. They found continuous rotating instruments (Protaper and K3XF rotary system) could produce dentinal crack formation. Root canal instruments with Reciprocating movement (Wave one system) appear tobe preferable to a continuous rotational movement. Comparably, the findings of this study support those of HakanArslan et al.'s 2014 investigation, which used the Protaper Universal, Endoflare, Revo-S, and HyFlex devices to study root canal flaring. In terms of crack formation, they discovered that using the Gates Glidden drills increased the rate of crack creation in comparison to the Protaper Universal, Endoflare, Revo-S, and HyFlex flaring instruments, and it was comparable to the control group's results. This could be because the design of the file creates a swaggering motion that lessens the torque and screw effect on a particular file by reducing the amount of contact between the file and the dentin.

CONCLUSION: Within the limitation and standardization conditions of this study, it can be concluded that the fracture resistance of the roots instrumented with the WaveOne files or obturated with epoxy resin–based sealer(AH plus) was compared Hyflex CM regenerative file system showed similar resistance to vertical root fracture as compared to the control group.

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